Evaporation waves: experimental results

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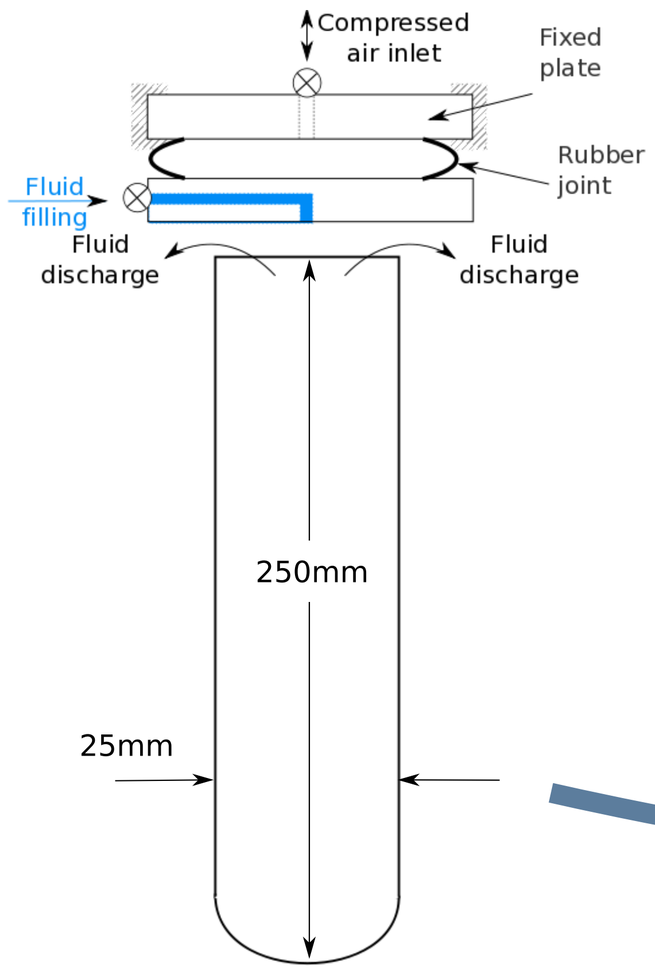
Experimental set-up



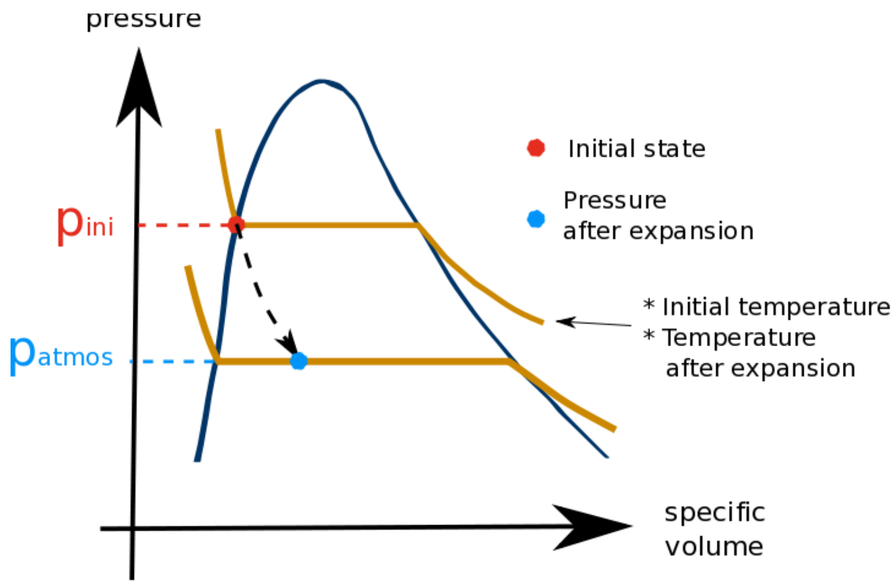
» Tube: glass
» Initial pressures: 3-10 bar
» Initial temperatures: 0-40 °C

Fluid: R134A

@ 25°C
» v_l = 0.0008309 m^3/kg
» v_v = 0.0298 m^3/kg

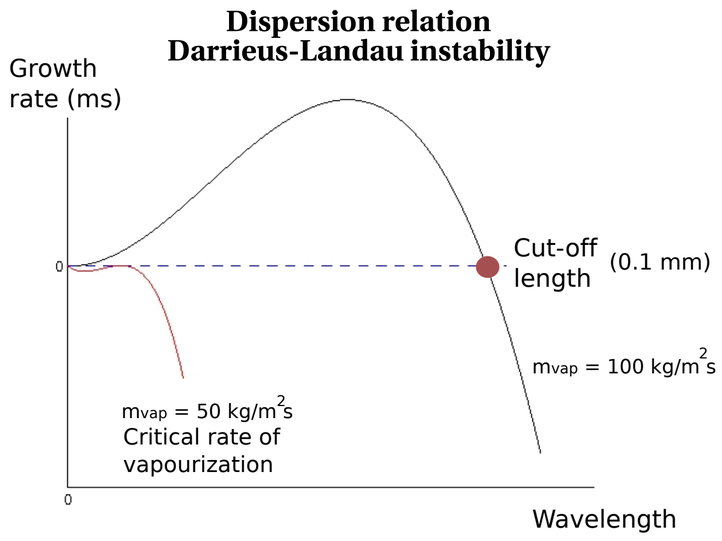
Saturation
» T = 0° => p* = 2.93 bar
» T = 40° => p* = 10.16 bar

Depressurization process

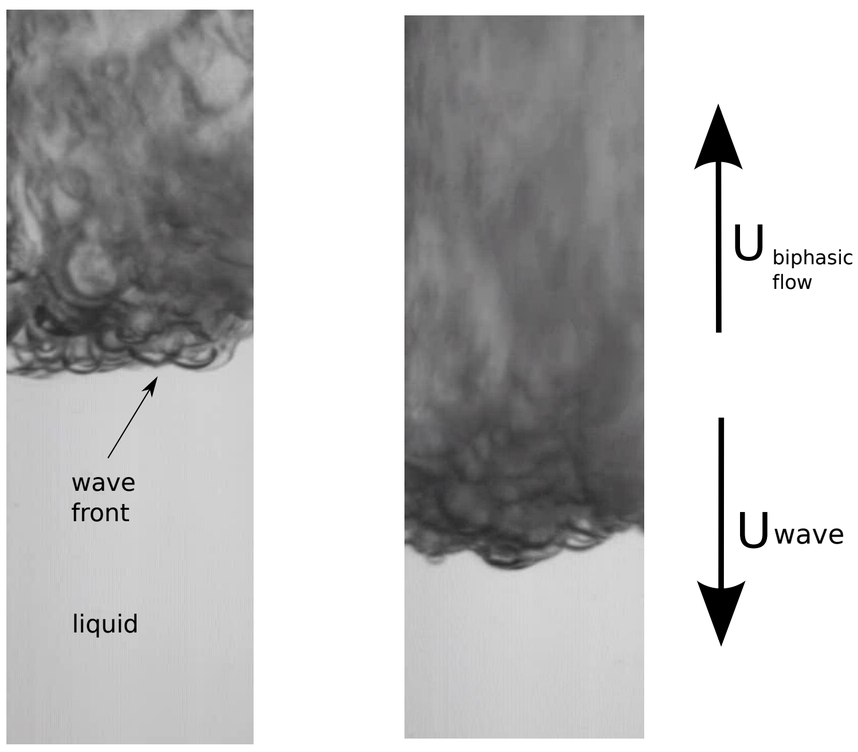


» Fast depressurization renders the liquid metastable
* Pressure drops
* Temperature remains the initial

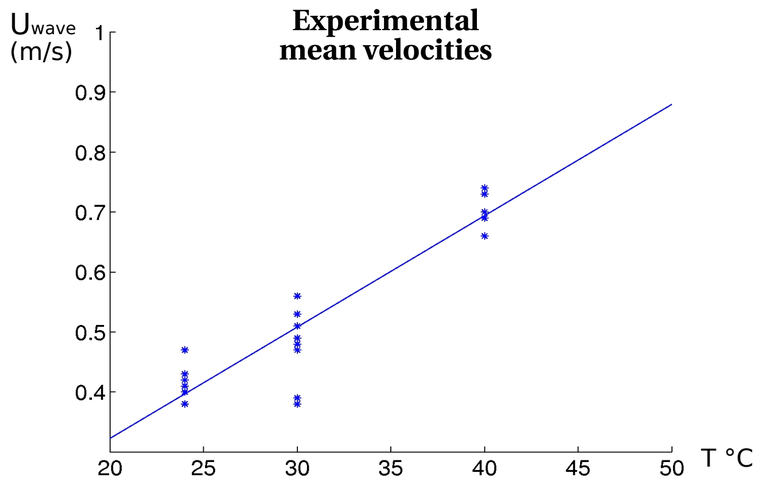
Fast depressurization
Instability Darrieus-Landau



Evaporation wave

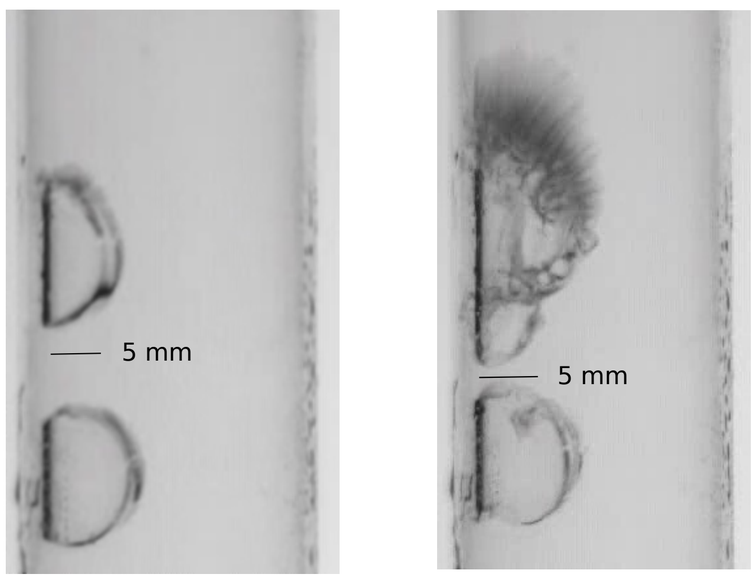


» The initially planar interphase is Darrieus-Landau unstable for pressure ratios $p_{ini}/p_{atmos} > 4$ leading to evaporation waves.
» Surface tension stabilizes the short wavelengths
» $U_{wave} \sim 40$ cm/s » $U_{b.flow} \sim 20$ m/s



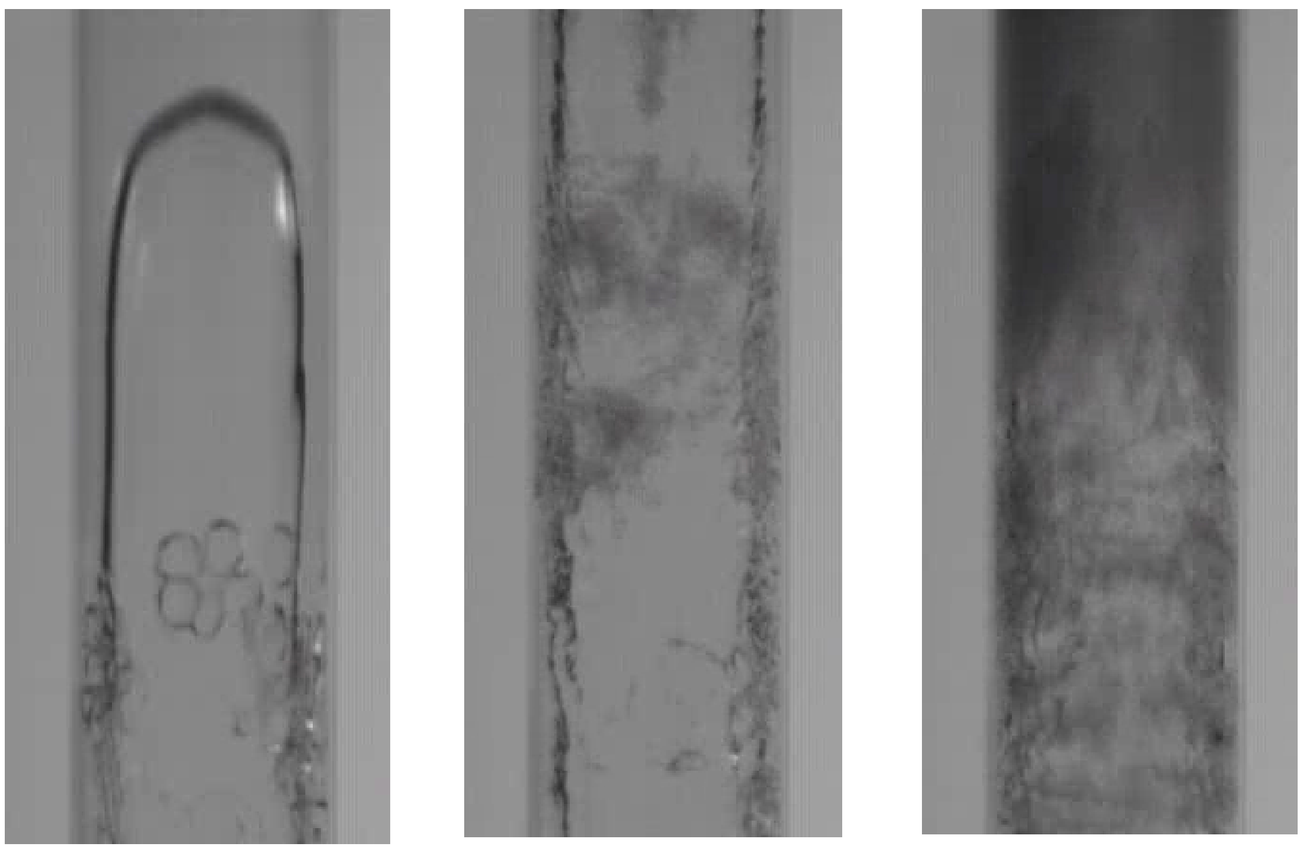
Other pheomena

Lateral bubbles



» Inappropriate degassing during the filling of the tube can lead to the formation of bubbles at the walls.
» Smooth initial growth but ultimately becoming Rayleigh-Taylor unstable, increasing explosively the surface of vapourization.

Taylor bubbles



» Originate at the bottom.
» Surprisingly smooth, as Taylor bubbles.
» The lateral layer left by the bubble ultimately destabilizes and leads to an explosive vapourization.

References

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Acknowledgements

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